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# Modern condition of locations of municipal solid waste in a residential buffer suburb of the city of Almaty

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# Overview

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# Purpose

The purpose of this work is to study by using different methods the existing waste disposal sites in the city of Almaty. In Almaty and its buffer zone, the issues of allocation of MSW are very relevant due to the increase in the city's area, the constant growth of the population, a significant number of temporary lived tourists and tourists visiting the city each year. The modern development of human economic activity, the increase in the number of people results in environmental pollution by wastes of their production and consumption. The objects of municipal solid wastes storage can adversely affect not only the health of local residents, but also the socio-economic indicators of the city, comprehensively affecting the components of the environment.

# *Introduction*

Cities in the economy of many states are important; they are the poles of growth. Thus, soils contaminated during the washing out of the landfill with heavy metals and other toxic substances, without costly reclamation become unfit for further economic use. Transformation of natural landscapes as a result of creation and functioning of open places for disposal and storage of solid municipal and household waste undoubtedly result in the deterioration of ecological situation both in the city and in the suburban area.

The city of Almaty is currently a dynamically developing cultural and financial center of the Republic of Kazakhstan, which includes 8 districts and metropolitan area was 683.5 km2. The total population living in the city is 1,703,400 people.

With a dynamic population growth, the city is a generator of a large amount of solid municipal waste. More than 500 thousand tons was put to authorized and unauthorized landfills. Despite the fact that today there are effective ways to reduce solid waste in the world practice, in Kazakhstan, the bulk of them (97%) without sorting and preliminary separation into components falls on authorized and unauthorized landfills. Thus, there are prerequisites for increasing the number of landfills, as well as increasing the size (area, volume) of existing ones.

# *Benchmark data and methods of research*

Space images of municipal solid waste landfills with a spatial resolution of 21 m and a spectral resolution optimal for the tasks to be solved, as well as the availability of retrospective materials that are in general access in the Sasplanet database and the client program Google Earth map were the benchmark data for the analysis, monitoring and modeling of the MSW landfills in the buffer zone of Almaty city. The materials were decoded using the ArcGIS 10.3 multifunctional geographic data processing software. On their basis, the analysis of long-term changes in the boundaries of existing municipal waste disposal sites for the period of 2003-2016 was carried out. Informative, cartographic characteristics - the area and perimeter (total length of the border) of the landfill are among the indicators reflecting the dynamics of objects. The changes of the area were calculated in relation to the data of the previous survey. The decoding of the images of space objects storage and consumption was carried out in several stages, which combined the spatial linkage of the raster map, the digitization.

# Results and discussion

Within the framework of the project "Development of an Economic Mechanism for Solving the Problem of Pollution of Buffer Zones by Municipal Solid Wastes (in the City of Almaty)", the research work was carried out from 2015 on determining the state of 8 consumer waste disposal facilities in the suburban buffer zone of Almaty city.

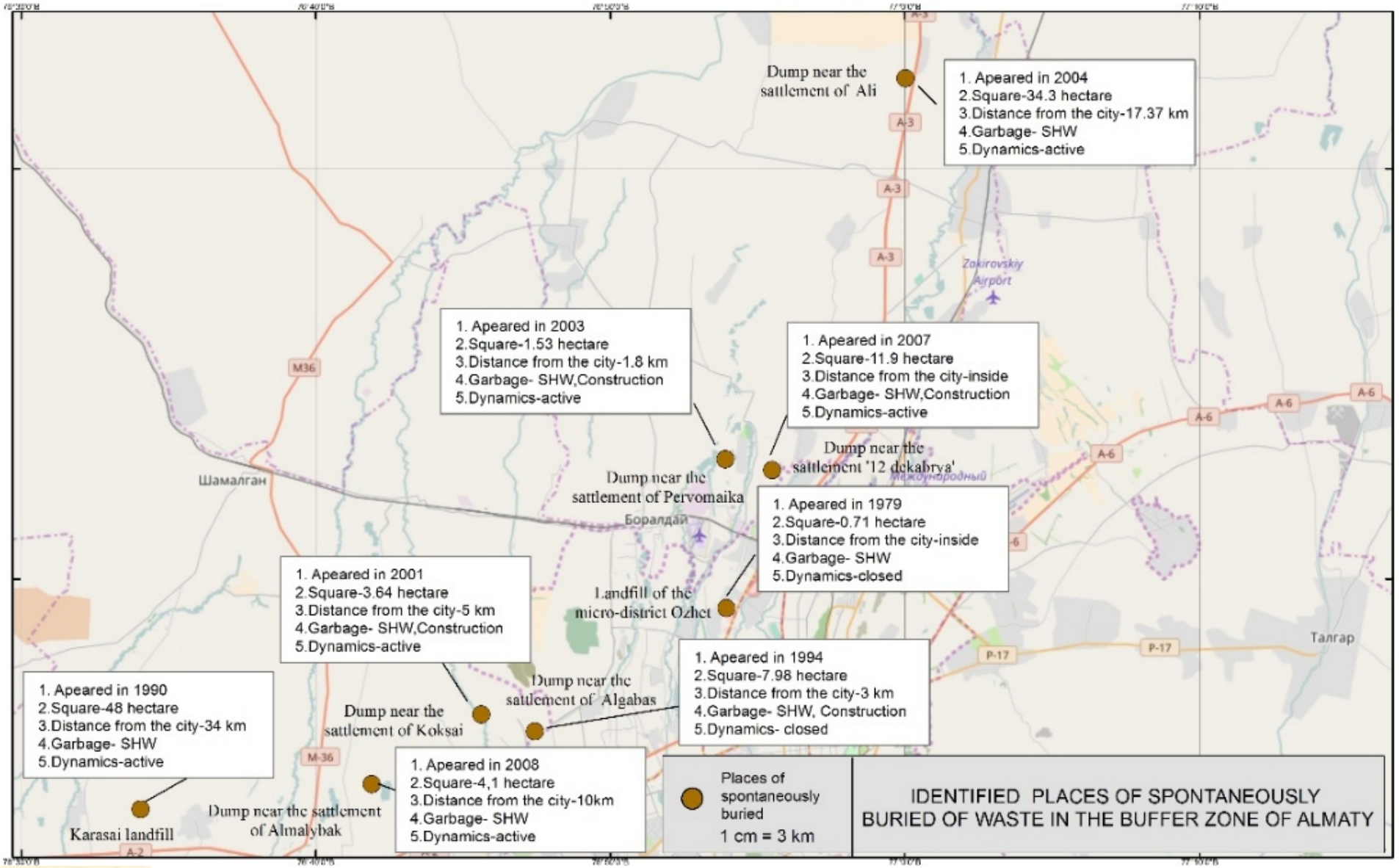
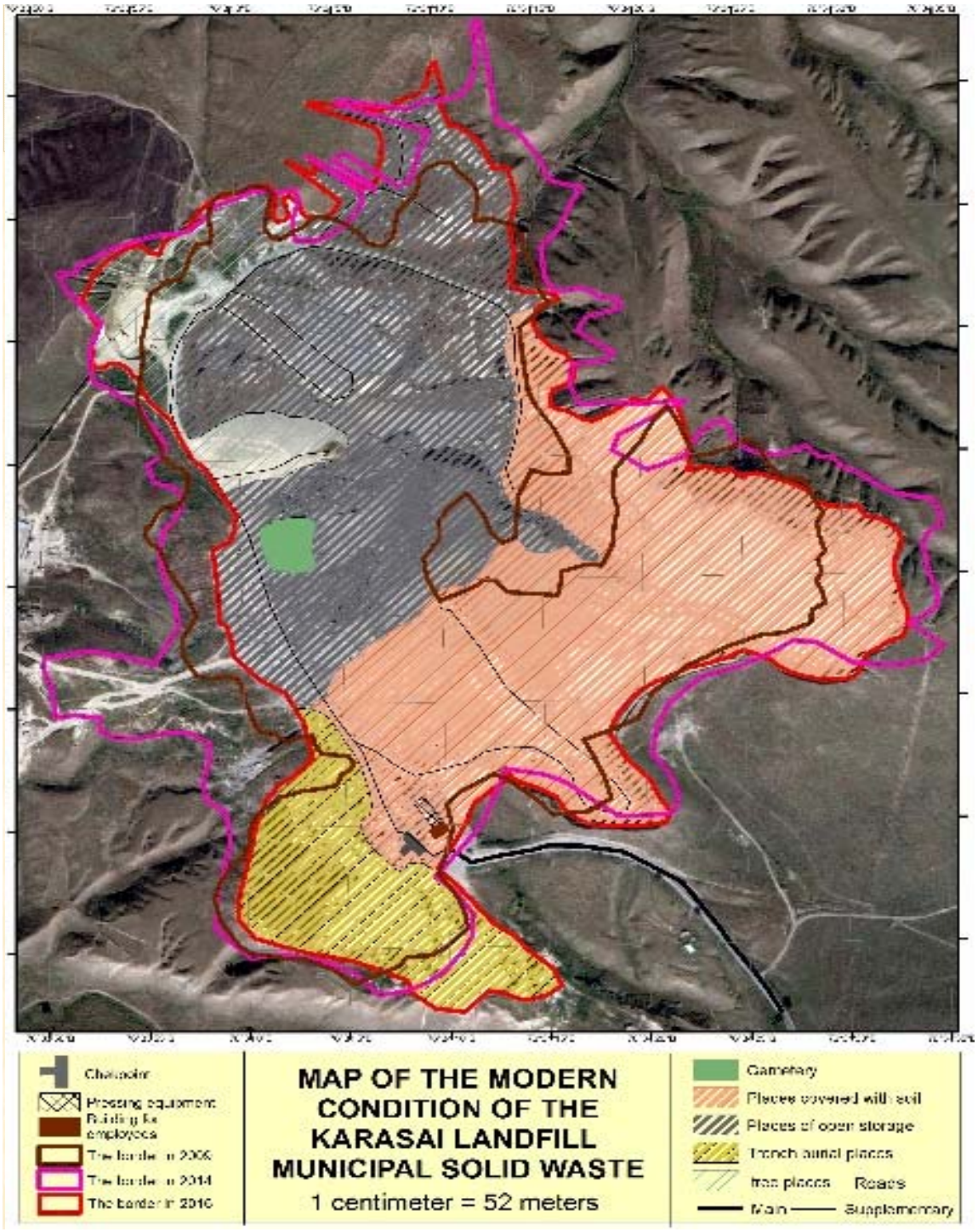
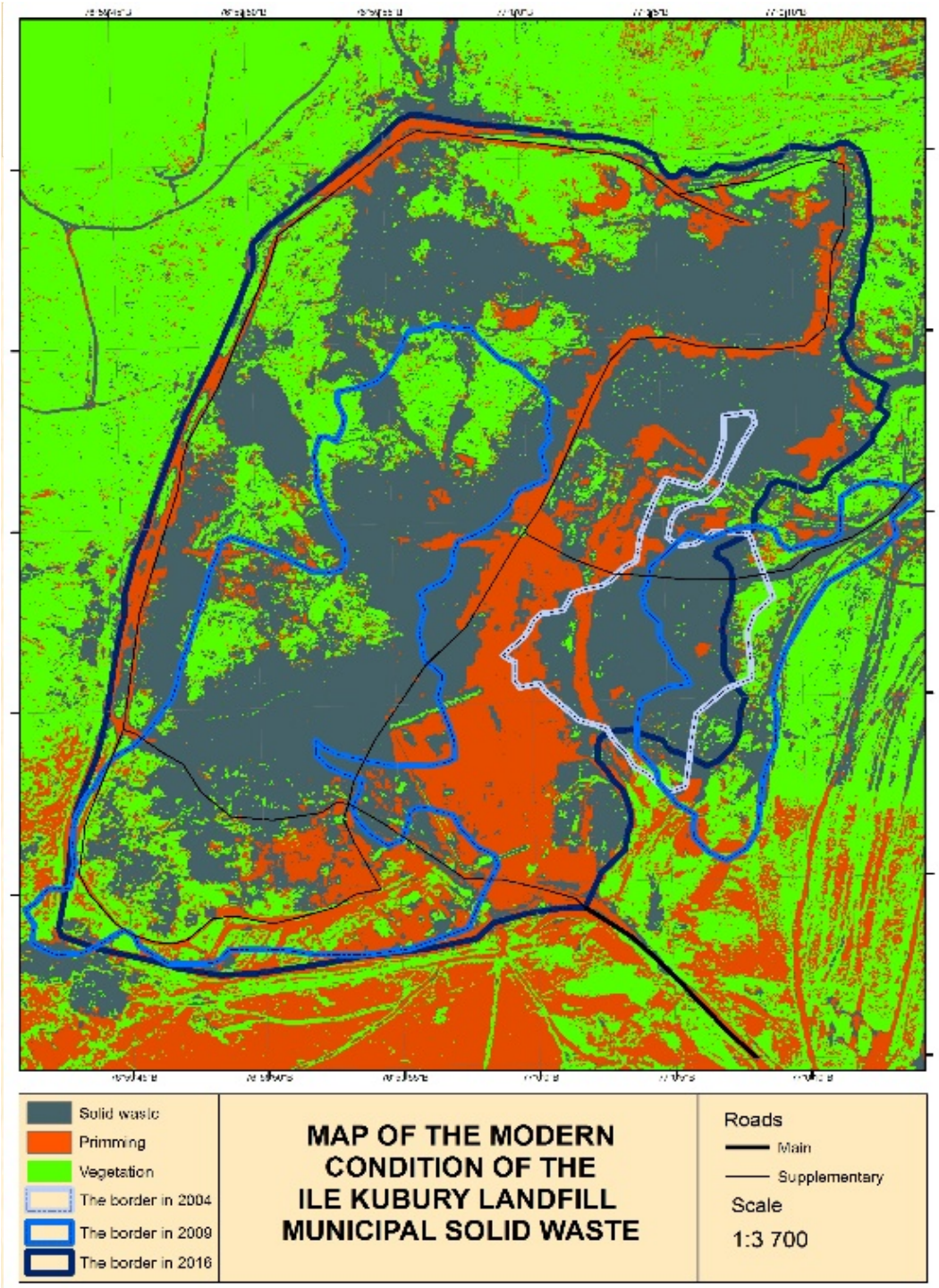



Figure 1 - Location of burial sites of municipal waste in Almaty and the suburban area




- Figure 2 - Current state and dynamics of changes in the boundaries of the Karasai MSW landfill for 2009-2016.




- Figure 3 - Dynamics of changing the boundaries of the landfill "Ile Su Kubyra" near the village of Ali for 2004-2016.

# Pictures of the current state with visual observation landfill of Ali "Ile su Kubyry"

# Pictures of the current state with visual observation landfill of Ali "Ile su Kubyry"

# Figure 4 - Dynamics of changes in the boundaries of the former urban MSW landfill in micro-district Ozhet for 2002-2016 years [28]


Landfill in micro-district Ozhet is located in Alatau District of Almaty, put into operation in 1976. This landfill was close to the city at the time of opening. With the expansion of the city's borders, it found itself within the city limits.

In 1990, due to overfilling and non-compliance with the sanitary protection standards of the distance from the city, its operation was suspended and the Karasai landfill was opened. According to our research in 2002, the landfill area was 45.5 hectares, in 2012 it was 27.8 hectares, and in 2016 it was 10.65 hectares. For this period the area of the landfill had a negative reduction dynamics of 34.35 hectares (Figure 4). Around the landfill for the past 25 years, Ozhet micro district and trade and market complexes appeared.

- The analysis of the obtained results allows forming a generalized table that characterizes the main requirements for sanitary sites, which provide for the observance of storage technology, the availability of engineering structures and control over the impact on environmental objects. There are the main components for the functioning of the landfills: location (region, district, locality), permitting documents, design capacity in tons, waste disposal limit (tons), landfill operation period, area in hectare, current operation, environmental impact assessment, the nearest settlements.
- Landfills that do not meet the requirements can be considered as authorized non-equipped waste disposal sites (Table 1).

# Table 1 - Characteristics of the studied MSW landfill in suburban buffer zone of Almaty city

| Name of landfill | Karasai landfill (Karasai region) | Landfill close to Ali settlement "Ile su Kubyry" (Ili region) | Landfill close to md. Ozhet (Almaty city) | Landfill close to the international airport in Almaty |
|---|---|---|---|---|
| Location (district, region,settlement) | Karasai region, town of Kaskelen, highway Almaty-Bishkek 6457. The facility is located in the Karasai district at 1.5 km. west of the village of Atey | Ili district, Otigen batyr settlement, Aeroport street, b / n. The object is located 12 km. north-west of the village of Otigen batyr | Officially closed landfill | GKP "Tazar", near the highway Almaty-Narynkol 27 km, from the international airport of Almaty at a distance of 17.5 km |
| Permits | Operating landfill with all permits | Operating landfill with non-compliant permits | - | Officially closed landfill |
| Project capacity, tons | 523500 tons/year | 9200 tons/year | - | - |
| Waste disposal limit (tons) | 858802.8 | 776306 | Closed in 1990 | - |
| Period of operation of landfill | Since 1990 | Since 2013 | | From 2000 till 2013 |
| Space, hectars | 57.73 | 34.3 | 10.65 | 9.72 |
| Current operation | active | active | Closed, re-cultivation activities unknown | Closed by the specialized inter-district economic court of Almaty region in 2012, recultivated |
| Environmental impact assessment | Relatively safe, there is a smell in the radius of 500 m | there is a smell in the radius of 1000 m | | |
| Nearest settlement | settlements Aitei, Ushterek | Settlements Ali, Soyuz, Rassvet-2, summer cottages Pobeda, Pchelka. 800 m | Micro-districts Ozhet and Karasu | From the international airport of Almaty at a distance of 17.5 km., and from the runway - 14.7 km |

- According to satellite images on the investigated territory, we detected 5 illegal dumps with total area of 55.33 hectares. Although according to environmental requirements, the storage of waste in unauthorized places and the formation of spontaneous landfills are prohibited.
- These places of waste storage are in the 1st category - spontaneous landfills, which are characterized by the lack of engineering and environmental surveys for the territory, environmental monitoring, not having the sanitary protection zone and the water protection zone.
- On the basis of visual observation, it was established that 4 dumps from 5 identified waste storage sites have been filled up to the present time, since there is no proper control over the storage facilities. Based on the analysis of the results obtained, Table 2 is compiled with the following characteristics:
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# Table 2 - Characteristics of the investigated storage sites for municipal solid waste in the suburban buffer zone of Almaty

| № | Location (district,region, settlement | Period of operation of the dump | Area at 2016, hectars | Current operating | Composition of waste | Environmental impact assessment | Technical condition and technological equipment | The nearest settlement |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | Dump near settlement KIZ (Karasai district) | | 3,92 | active | Municipal solid waste | Smell in the radius of 900 m | Not fenced, there is no checkpoint and weighing platform | s.Almalybak, Zhalpaksai |
| 2 | Dump near settlement Koksai (Karasai district) | | 16,52 | active | MSW, construction waste | Smell in the radius of 900 m | Not fenced, there is no checkpoint and weighing platform | s.Koksai |
| 3 | Dump near settlement Algabas (Almaty city) | Since 1987 till 2012 | 10,65 | Oficially closed in 2012 | Municipal solid waste, construction waste | - | Fenced with galvanized steel | s.Algabas |
| 4 | Dump near settlement the 12 of December (Ili district) | | 7,64 | Closed in 2013 | Municipal solid waste | - | fenced, there is no checkpoint and weighing platform | s. the 12th of December |
| 5 | Dump near settlement Pervomay (Almaty city) | | 16,6 | active | MSW, construction waste | Smell in the radius of 700 m | Not fenced, there is no checkpoint and weighing platform | s.Koyankus, Ashibulak, peasant farming |

## *Figure 6 - Dynamics of changes in the boundaries of the dump near the settlement KIZ (Almalybak) for 2009-2016. [28]*


- The dump near the village of Kiz (Almalybak) is located in the Karasai district of the Almaty region. The nearest settlements are Almalybak and Zhalpaksay. Lake is located - 19 km at 300 meters to the east of the dump, which contradicts sanitary norms and rules. As it can be seen from the decoded photographs, the area and shape of the dump increased northward from the original shape. In 2009, the dump area was 2.73 hectares, in 2012, it was 4 ha (increased by 1.19 hectares), in 2016, it was 3.92 ha. (Figure 6). The reduction of the boundaries of the landfill in 2016 is related with a partial backfilling of the surface occupied by the waste with the land.

# Pictures of the current state with visual observation *the settlement KIZ (Almalybak)*


Figure 7 - Dynamics of changes in the boundaries of the solid waste dump near the village of Koksai for 2012-2016.

The dump near the village of Koksay is located in the northern part of the village of Koksay, Karasai district, Almaty region. The remoteness of the dump from the border of Almaty is 1.85 km. The nearest settlements are Koksay and Algabas. In 2012, the landfill area was 16.7 hectares, in 2016 it decreased by 0.18 hectares and was 16.52 hectares. According to the decoding data, the dump's shape is stretched along the road. Municipal Solid waste is scattered along the road. There is a river near the landfill. Due to on geographical conditions, it is obvious that groundwater can be polluted. (Figure 7).

# Pictures of the current state with visual observation dump near the village of Koksay

***Figure 8 - Dynamics of changes in the boundaries of the solid waste dump near the village of Algabas for 2000-2016. [28]***


Dump Algabas is located in Algabas microdistrict of Almaty. The figure shows that in 2000 the area was 10.2 hectares, and in 2016, it was 12.1 hectares. The change in borders has not increased significantly. The dump waste is evenly distributed. The shape of the dump boundary is clearly distinguished. Kargalinka River flows near the dump to the east. The spontaneous dump is officially closed in 2012, it refers to the recultivated, and it does not have a fcomplete fence along the actual border, as well as there is no sanitary protection zone along the perimeter of the dump (Figure 8).

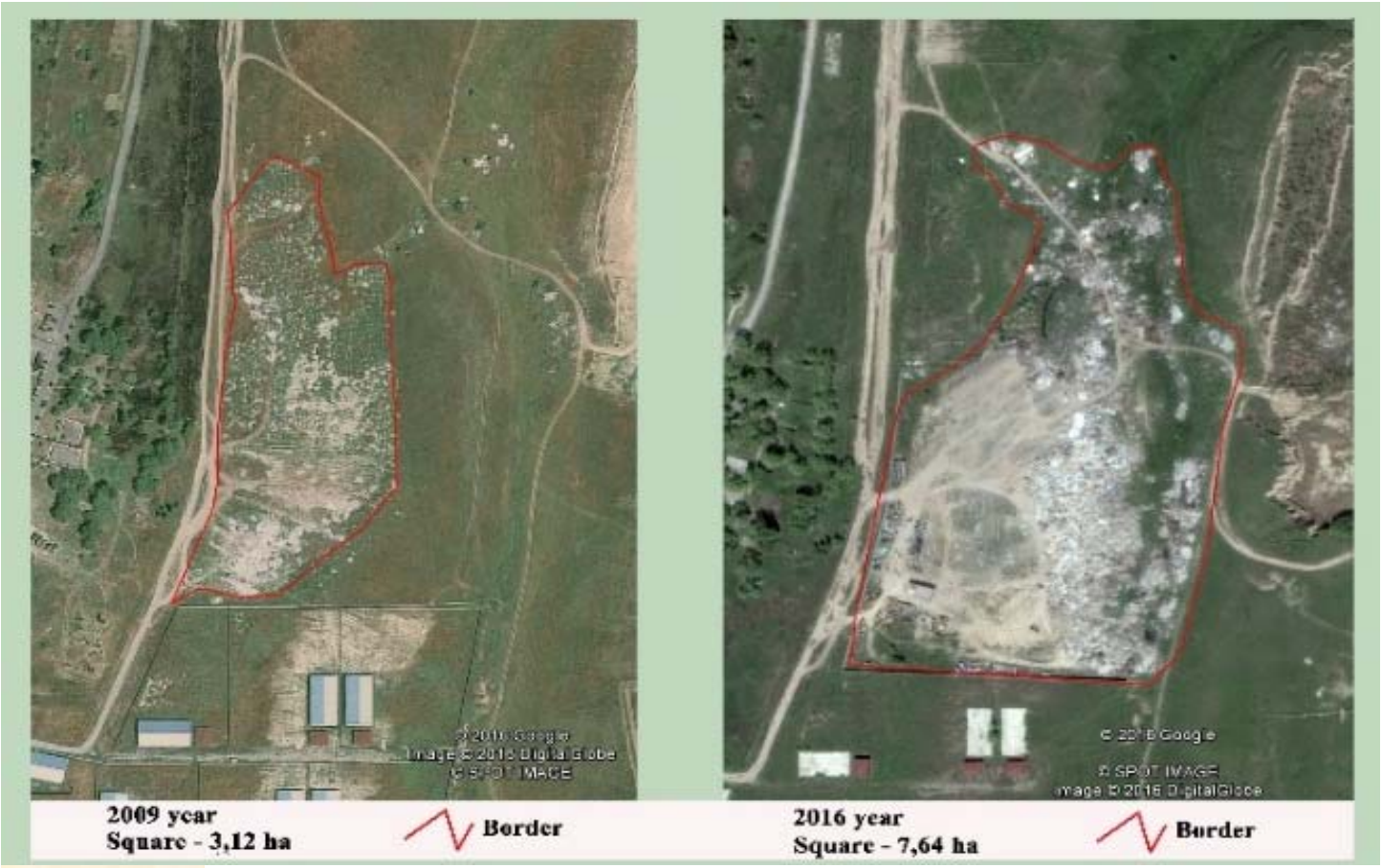


Figure 9 - Dynamics of changes in the boundaries of the solid waste dump near the settlement "December 12" for 2009-2016.

The dump of municipal solid waste near "12-December" is located in the Ili district of Almaty region. Currently, the landfill area is 7.64 hectares. The spontaneous dump is officially closed in 2012. It is located in close proximity (976 m) from the recreation area Pervomaiskie ponds, which contradicts sanitary norms and rules. According to the visual observation, the waste is predominantly MSW. The waste is poorly compacted, and the northern part of the landfill is scattered around the edges of the dump. There is an active growth of the dump area. In 2009, the landfill area was 3.12 hectares and in 2016 it doubled to 7.64 hectares. There is no sanitary protection zone around the perimeter of the dump (Figure 9).

Figure 10 - Dynamics of changes in the boundaries of the dump of MSW near the settlement "Pervomayka" for 2004-2016.


The dump near the settlement of Pervomayka is located near the settlement Pervomayka of the Ili district of Almaty region on the border of Almaty city. The nearest settlements are Pervomayka and Koyankus. The dump has been in operation since 2004, it refers to recultivated, it does not have a complete fence along the actual border. There is an increase in the territories from the initial state. In 2004, the dump area was 1.90 ha. In 2016, it increased by 14.7 hectares and was 16.6 hectares. On space images, it is possible to observe a smooth compaction of waste along the perimeter of the dump (Figure 10).

# Pictures of the current state with visual observation settlement "Pervomayka"

Transformation of the environment in waste sites is related with simultaneous mechanical, physical, physical and chemical, chemical, biochemical and biological processes.

As a result, changes in the landscape, properties and condition of the soil, the composition of surface and groundwater, the intensity and nature of exogenous geological processes take place. The complexity of the study is that mechanical, thermal, physicochemical, chemical and biological effects are superimposed, summarized, suppressed and modified in the real situation.

All these processes cannot be studied only by the remote sensing of the Earth method, we performed only a ground-level visual survey of the MSW storage sites

# Conclusions

As we can see, in our country there is a legal and regulatory base in the field of MSW management. However, a weak mechanism for monitoring the execution of adopted laws and a large number of regulatory acts reduces the effectiveness of their actions to zero. Moreover, it causes irreparable harm to the environment, to the health of the population, and also results in the development of legal failure to comply with standards in the  in the society. As a result of the research, the following conclusions can be drawn:

- the increase of the volume of generation and accumulation of unsorted municipal solid waste and industrial waste;
- the non-compliance of the existing landfills with regulatory requirements (there are currently 2 landfills in the study area, one of them does not meet the ecological and sanitary requirements (Ile Su Kybary landfill), the second landfill, in some extent, meeting the current building and sanitary standards, has a permit for Emission into the environment, but it exhausts its design capacity;
- the lack of a clear differentiation of the powers and responsibilities of state bodies in the sphere of handling waste of production and consumption;
- the lack of a united national center, which forms a unified national waste database, processing technologies (recycling), which results in unreliable data on the movement of waste in the country, distorts the overall "picture" of the actual situation in this area;
- the existing legislation does not provide for liability of companies for the disposal of their waste;
- the market of waste processing is practically not developed (especially small and medium business), due to the lack of a system of separate collection of garbage in our country;

- the total area of landfills and spontaneous landfills grows;
- there are no economic incentives that could induce entrepreneurs to collect and process waste;
- there is no control over the handling of toxic waste, including their disposal (for example, fluorescent lamps, mercury-containing devices (thermometers), batteries, etc.) they are thrown out by the population together with household rubbish;
- the radius of the location of landfills and dumps is close to the settlements and water bodies;
- there is no information on reclamation of closed 2 landfills;
- the land of the former landfill of MSW near Ozhet settlement without observing sanitary and epidemiological standards is used for construction of residential houses and markets;
- in terms of landfill size and dump size, medium and large waste storage sites predominate.

Thank you for attention!!!